ME – 7

THE COMPARISON OF EFFECTIVENESS OF PROJECT-BASED LEARNING AND PROBLEM-BASED LEARNING ON THE SPACE MODEL OF FLAT SIDE IN TERMS OF ACHIEVEMENT OF LEARNING OBJECTIVES STUDENT

Raoda Ismail
Graduate Student in Yogyakarta State University
raodaismail26@gmail.com

Abstract

This study aims to describe: (1) the effectiveness of project-based learning (PjBL) in the subject matter of geometry flat side in terms of the attitude of confidence, achievement of learning mathematics, and problem solving skills; (2) the effectiveness of problem-based learning (PBL) in the subject matter of geometry flat side in terms of the attitude of confidence, achievement of learning mathematics, and problem solving skills; (3) the comparison in the effectiveness between project-based learning and problem-based learning in the subject matter of geometry flat side in terms of the attitude of confidence, achievement of learning mathematics, and problem solving skills.

The data were analyzed descriptively and statistically. The kind of this research quasi-experiment using design control group non-equivalent. Instrument used in the form of test and non-test. The result of this study that are the significance level 5%, it can be infered that (1) project-based learning is effective in the subject matter of geometry flat side in terms of the attitude of confidence and problem solving skills; (2) problem-based learning is effective in the subject matter of geometry flat side in terms of the attitude of confidence, achievement of learning mathematics, and problem solving skills; (3) problem-based learning is more effective than project-based learning in the subject matter of geometry flat side in terms achievement of learning mathematics.

Keywords: project-based learning, problem-based learning, attitude of confidence, achievement of learning mathematics, problem solving skills.

Introduction

According to the National Council of Teachers of Mathematics, learning mathematics involves accumulating ideas and building successively deeper and more refind understanding (NCTM, 2000). A school matehamatics curriculum should provide a road map that helps teachers guide students to increasing levels of sophistication and depths of knowledge. Learning outcomes are well supported by a good learning process. good learning process is a learning process that can involve students actively in their learning content.

There are several models of learning that can support a good understanding of the concept, for example, is a project-based learning and problem-based learning. Project-based learning (PjBL) is one of the most effective ways available to engage students with their learning content, and for that reason, PjBL is now recommended by many educational leaders as a best instructional practice (Bender, 2012: 7). In another hand, Problem-based learning (PBL) engages students in intriguing, real, and relevant intellectual inquiry and allows them to learn from them to learn from these life situations (Fogarty: 1997:2).

Filcik, Bosch, Pederson, & Haugen (2012) have researched about effective project-based learning in terms of aspects of conceptual knowledge. The results showed that effective

project-based learning increases student conceptual knowledge. Ozdemir (2006) presented that project-based learning can improve learning achievement and attitudes towards geometry. Next is the result of research Tseng, Chang, Lou, & Chen (2013) which showed that collaboration between science with project-based learning can improve learning effectiveness and makes learning more meaningful. Furthermore, project-based learning is effective to improve student achievement (Tiantong & Siksen, 2013).

Some facts and results of these studies encourage researchers to compare the effectiveness of project-based learning and problem-based learning. As has been stated above that the model of project-based learning and problem-based learning model has its own advantages. Consideration of comparisons between the two models is to determine the learning model which is more effective in terms of student achievement of learning objectives, in this case the student is confident attitude, knowledge, and problem solving skills.

The purpose of mathematics education related to social groups as well as the underlying ideology, both in general and with regard to mathematics (Ernest, 1991: 125). The purpose of adult education is not only focused on the development of cutting-edge knowledge and skills, but also can shape students' competencies appropriate to the affective domain. In addition to the achievement of learning mathematics and problem solving skills, there are affective aspects that contribute to student success in learning mathematics. The affective aspect is confident. With the confidence of this, students have the ability to take appropriate and effective action in a variety of situations, although emerging challenges both from themselves and from others (Burton & Platts, 2006: 10). However, based on data obtained from the Trends in International Mathematics and Science (TIMMS, 2012: 338), Indonesia received a rating of 40 out of 45 countries in terms of the confidence of students in math. This phenomenon occurs, of course, influenced by some of the issues that have been raised previously. So, we need an effort to assist students in developing self-confidence, especially in the learning of mathematics.

Some research and facts found in the field to encourage researchers to compare the effectiveness of project-based learning model and problem-based learning model in terms of a confidence, achievement of learning mathematics, and problem solving skills. As has been stated above that the project-based learning and problem-based learning has its own advantages and disadvantages. Consideration of comparisons between the two models is to determine the learning model which is more effective in terms of student achievement of learning objectives, in this case the student is confident attitude, achievement of learning mathematics, and problem solving skills.

These three factors are the confident attitude of students, the achievement of learning mathematics, and problem solving skills in this study is referred to as the learning objectives to be achieved related to the implementation of project-based learning and problem-based learning in Junior High School.

After seeing the advantages of each of the learning model, it is necessary to study more about the comparative of effectiveness of project-based learning and problem-based learning. Based on the boundary problem has been stated previously, the formulation of the problem in this study are as follows:

1. Does project-based learning effective in terms of attitude confidence, achievement of learning mathematics and problem solving skills?
2. Does problem-based learning effective in terms of attitude confidence, achievement of learning mathematics and problem solving skills?
3. Is there a difference in the effectiveness of project-based learning model and problem-based learning model in terms of attitude confidence, achievement of learning mathematics and problem solving skills?

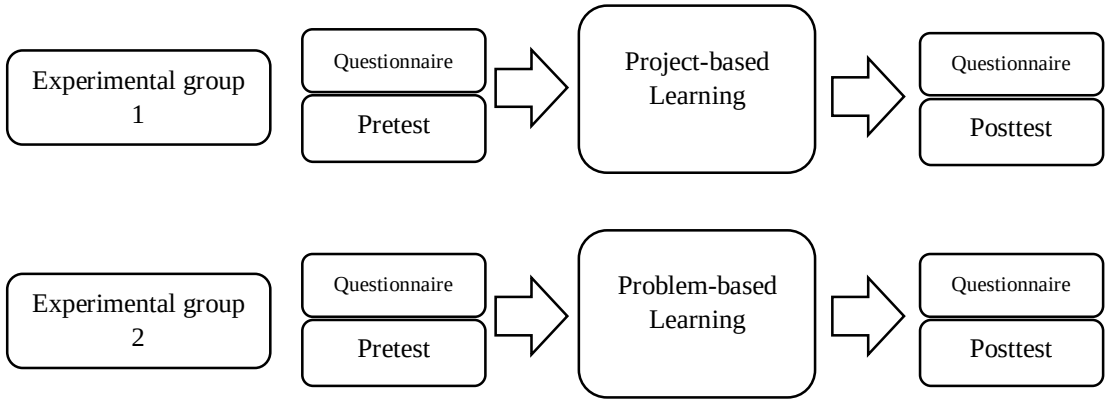
After describing the comparison of the effectiveness of project-based learning and problem-based learning, expected to describe the difference in the effectiveness of the model for project-based learning and problem-based learning model in terms of student achievement of learning objectives which include competence attitudes, knowledge and skills. Theoretically

benefit of this study is to describe the theory of theories about the differences and similarities of project-based learning and problem-based learning.

Methods

This study was a quasi-experimental. Researcj conducted at State Junior High School 9 Yogyakarta on February 6, 2015 to March 20, 2015. The population in this study were all eighth grade students of State Junior High School 9 Yogyakarta. The students of class VIII F assigned using project-based learning and students class VIII E assigned using problem-based learning were established as the sample using the random sampling technique.

The research design in the study are as follows



Picture 1. Research Design

The data in this study were collected through prestest and posttest of the attitude of confidence, achievement of learning mathematics, and problem solving skills. In terms of content validity, tests instruments and questionnaires fit for use according to the reviewer. In the terms of construct validity, based on the results of Confirmatory Factor Analysis (CFA), the attitude confidence showed that overall test results stating fit the model and the results for each parameter estimate also fit. The reliability tests of achievement of learning mathematics was 0,774 with standard error measurement was 1,99. The problem solving skills reliability was 0,726 with standard error measurement was 2,82. The attitude confidence questionnaire reliability was 0,600 with standard error measurement was 3,87.

The data analysis technique consists of descriptive analysis and statistical analysis. Descriptively, the data are showed based on the average, standard deviation, maximum score and minimum score. Statistical analysis using univariate and multivariate tests.

Result and Discussions

The results of this study were taken based on the factors that were observed and found during the research. These factors include learni

a. The Effectiveness of Project-based Learning in Terms of The Attitude of Confidence, Achievement of Learning Mathematics, and Problem Solving Skills

Based on the results of calsulations for normality and homogenity of variance test it appears that the data were normally distributed and homogeneous. The summary of One Sample T-Test results are resented in the following table.

Table 1. One Sample T-test of Project-based Learning Group

Group	*Dependent Variable*	*t*	*df*	*Sig.*
Project-based Learning	Attitude of Confidence	12,961	33	0,000
	Achievement of Learning Mathematics	-0,049	33	0,961
	Problem Solving Skills	7,003	33	0,000

The table above shows that the improvement of the attitude confidence and problem solving skills who studied with project-based learning. This is the evident from the results of calculations where H_0 is rejected for attitude of confidence and problem solving skills.

Learning mathematics by using effective project-based learning model in terms of each aspect of the study, namely the attitude of confidence, achievement of learning mathematics, and problem solving skills. This is according to the theory proposed by Bender (2012: 7), that "Project-based learning (PjBL) is one of the most effective ways available to engage students with Reviews their learning content".

Project-based learning provides a very good experience for students and can be used to review the previous lesson, or to start a new lesson (Harmin & Toth, 2006: 337). This is reflected in measures of project-based learning. These stages are (1) begins with an important question, (2) designing the project plan, (3) create a schedule, (4) to monitor student teachers and progress of the project, (5) assess the results, and (6) evaluation of the experience.

b. The Effectiveness of Problem-based Learning in Terms of The Attitude of Confidence, Achievement of Learning Mathematics, and Problem Solving Skills

Based on the results of calsulations for normality and homogenity of variance test it appears that the data were normally distributed and homogeneous. The summary of One Sample T-Test results are resented in the following table.

Table 2. One Sample T-test of Problem-based Learning Group

Group	*Dependent Variable*	*t*	*df*	*Sig.*
Problem-based Learning	Attitude of Confidence	9,724	33	0,000
	Achievement of Learning Mathematics	3,167	33	0,003
	Problem Solving Skills	4,397	33	0,000

The table above shows that the improvement of the attitude confidence, achievement of learning mathematics, and problem solving skills who studied with problem-based learning. This is the evident from the results of calculations where H_0 is rejected for each dependent variable.

Learning mathematics by using problem-based learning is effective in terms of each aspect of the study, namely the attitude of confidence, achievement of learning mathematics, and problem solving skills. This is consistent with the theory advanced by Eggen & Kauchak (2012: 307) that "problem-based learning is a teaching model that uses a set of problems as the focus for developing problem solving skills, materials, and self-regulation". It is seen from the steps in the problem-based learning. These steps are: (1) find the problem, (2) build a working structure, (3) define the problem, (4) collects a variety of information, (5) formulate solutions, and (6) evaluation.

c. The Comparison in The Effectiveness between Project-based Learning and Problem-based Learning in Terms of The Attitude of Confidence, Achievement of Learning Mathematics, and Problem Solving Skills

Learning mathematics with project-based learning and problem-based learning is a learning that is equally effective in terms of each of the dependent. Subsequent analysis was to

examine differences in the effectiveness of the learning model in terms of a confidence, achievement of learning mathematics, and problem solving skills simultaneously. For this purpose, the two group MANOVA statistical test is performed to determine whether there are differences in effectiveness between project-based learning and problem-based learning to see whether there is a distinction has mean or not between project-based learning and problem-based learning in terms of a confidence , the achievement of learning mathematics, and problem solving skills. Results of MANOVA test with SPSS 20 for windows are presented in the following table.

Table 3 The Results of MANOVA Test

Kriteria	*F*	*Hyp. Df*	*Error df*	*Sig.*	H_0
Wilks' Lambda	8,678	3	64	0,000	Rejected

The table above shows that by using the criterion of Wilks' Lambda obtained F value of 8,678 with 0.000 significance. With a significance level of 0.05, the significance value obtained is less than 0.05. Thus we can conclude that H_0 is rejected or the mean difference between project-based learning and problem-based learning in terms of a confidence, achievement of learning mathematics, and problem solving skills.

Furthermore, to find a more effective learning model in terms of each aspect of the univariate two-sample test was done using SPSS 20 for windows that use independent samples test with H_0 is rejected if the criteria of significance value less than 0.05. Univariate test results are presented in the following table.

Table 4 The Results of Univariate Test

Dependent Variable	*t*	*df*	*Sig.*	H_0
Attitude of Confidence	0,415	66	0,679	Accepted
Achievement of Learning Mathematics	-2,406	66	0,019	Rejected
Problem Solving Skills	0,897	66	0,373	Accepted

The table above shows that there are differences in effectiveness between the groups of project-based learning with problem-based learning groups in terms of the variables studied mathematics achievement. Obtained significance value of 0.019 is less than 0.05. This suggests that the problem-based learning model is more effective than a project-based learning model in terms of the achievement of learning mathematics.

The absence of differences between groups of project-based learning and problem-based learning groups in terms of the attitude of confidence and problem solving skills have been described in the previous paragraphs. Treatment of class that uses project-based learning model and a class that uses a problem-based learning model is very supportive for the development of an attitude of confidence and problem solving skills.

Problem-based learning model is more effective than a project-based learning model in terms of the achievement of learning mathematics. This is because the problem-based learning, students learn to solve a problem will apply their knowledge or trying to find the necessary knowledge. Learning can be more meaningful and can be expanded when students are faced with a situation where the concept is applied. Then, in a problem-based learning model, students integrate knowledge and skills simultaneously and apply it in a relevant context.

Conclusion and Suggestion

The result of this study show that at the significance level of 5%, it can be infered that

a. Project-based learning is effective in the subject matter of geometry flat side in terms of the attitude of confidence and problem solving skills;

b. Problem-based learning is effective in the subject matter of geometry flat side in terms of the attitude of confidence, achievement of learning mathematics, and problem solving skills;
c. Problem-based learning is more effective than project-based learning in the subject matter of geometry flat side in terms achievement of learning mathematics.

Suggestion can be submitteds are

a. Project-based learning and problem-based learning effectively in terms of a confidence and mathematical problem solving skills. Therefore, both this model can be used as an innovation in learning to support improved student achievement of learning objectives in the Curriculum 2013. Where students do not just rely on the competence of knowledge, but also attitudes and skills competency.
b. Problem-based learning is more effective than a project-based learning model in terms of learning mathematics achievement. This could be a suggestion for teachers to give students the chance to discuss the group to investigate a matter or sub material and then the student must account for what they have learned both to themselves, the group and to the teacher.

Bibliography

Bender, W. N. (2012). *Project-based learning; differentiating instruction fot the 21st century*. United Stated: Corwin.

Burton, K., & Platts, B. (2006). *Building confidence for dummies*. West Sussex: John Wiley & Sons, Ltd.

Eggen, & Kauchak, D. (2012). *Strategi dan model pembelajaran: mengajarkan konten dan keterampilan berpikir*. Boston: Pearson.

Ernest, P. (2004). *The philosophy of matematics education*. British: Tylor & Francis Group.

Filcik, A., Bosch, K., Pederson, S., & Haugen, N. (2012). *The effects of project-based learning (PjBL) approach on the achievement and efficacy of high school mathematics students: a longitudinal study investigating the effects of pjbl approach in mathematics education*. Proceedings of The National Conference On Undergraduate Research (NCUR), Weber State University, Odgen Utah.

Fogarty, R. (1997). *Problem-based learning and other curriculum models for the multiple intelligences classroom*. Glenview: Pearson SkyLight.

Harmin, M., & Toth, M. (2006). *Pembelajaran aktif yang menginspirasi: buku pegangan lengkap untuk guru masa kini*. Alexandria: the Association for Supervision and Curriculum Development (ASCD).

Kirk, R. E. (1995). *Eksperiment design: procedures for the behavior sciences*. United States: Library of Congress Cataloging in Publication Data.

NCTM. (2000). *Principles and standards school mathematics*. United States: The National Council of Teachers of Mathematics, Inc.

Ozdemir, E. (2006). *An investigation on the effects of project-based learning on students' achievement in and attitude towards geometry*. Middle East Technical University, Turkey.

Tan, O. S. (2009). *Problem-based learning and creativity*. Singapore: Chengange Learning.

Thomas, J. W. (2000). *A Review of research on project based learning. california: the autodesk foundation.* California: The Autodesk Foundation.

Tiantong, M., & Siksen, S. (2013). *The online project-based learning model based on student's multiple intelligence*. International Jurnal of Humanities and sosial science, Volume 3, No 7.

TIMSS. (2012). *TIMSS 2011 International Results in Mathematics*. Amsterdam: TIMSS & PIRLS International Study Center.

Tseng, K.H., Chang, C.C., Lou, S.J., & Chen, W.P. (2013). Attitudes towards science, technology, engineering and mathematics (STEM) in project-based learning (PjBL) environment. *Internasional Journal Techno Des Education*, 23, No. 87-102.